

Paczyme® - Organic Soil Stabilizer

- Reduces Permeability
- Compaction Agent
- Improves Performance on Salt-Affected Soils
- Increases CBR and UCS Properties of *in situ* Soil
- Highly Concentrated - Easy to Transport
- 100% Australian Made
- Environmentally Benign

History

Paczyme is the result of over twenty-five years of research into “non-standard” soil stabilizing agents. It was developed by combining proven surfactant wetting agent formulations with novel biological-based (rather than chemical) active ingredients.

Description

A highly concentrated liquid biochemical used for soil stabilization which is entirely biodegradable and non-toxic. Paczyme is an effective aid to the workability, mixability, binding and compaction of soils. When used in the construction of roads, airstrips, dams and other related projects, significant improvements are achieved. These are reflected in the following areas:

- Reductions in maintenance and re-sheeting schedules
- Some reduction in dusting
- Greater stability and durability in wet conditions
- Greater use of marginal clay materials
- Cost savings in construction and maintenance
- Minimal environmental impact, in contrast to petroleum based stabilizers.

Soil Types

Paczyme is most effective when working with soils having a PI of 8 or above, and with 15% passing a sieve size of 75 microns. It is advised that soils be tested prior to application to establish whether the soil is suitable for treatment.

Paczyme is a unique product that significantly improves soil stability. Developed from proven soil stabilization formulations, Paczyme effectively enhances the workability, mixability, binding and compaction of soils.

When used in the construction of roads, airstrips, dams and other related projects. Paczyme enables significant engineering improvements to be achieved.

Paczyme catalyses permanent physical and chemical changes in soil which result in increases in strength, durability and compaction densities. Clay soils treated with Paczyme develop an increased resistance to moisture infiltration.

Cost savings are achieved by increasing construction productivity, greater use of marginal clay materials and significantly lowered maintenance requirements.

Paczyme is a natural, non-toxic biodegradable liquid concentrate that mixes easily in water for application with standard water spraying equipment.

Paczyme is a low cost additive with long lasting effects. By altering the physical and chemical characteristics of soil, materials treated with Paczyme retain higher performance levels and extended life span.

Areas of Application

Unsealed Roads

Paczyme allows marginal clay materials to be used for the successful construction of significantly stronger, denser and more durable unsealed roads.

Paczyme facilitated resistance to moisture infiltration, decreases soil swelling characteristics and reduces the risk of pavement surfaces becoming slippery and dangerous during wet conditions.

Roads treated with Paczyme have achieved maintenance schedule reductions of up to 80%. Less dusting occurs, improving safety and preserving fine road materials.

Cost savings are achieved by

- Reduced maintenance schedules
- Use of substandard clay gravels that previously would have been discarded
- *In situ* recycling of existing gravel roads rather than complete re-sheeting
- Increased construction productivity gained by carting less water, easier mixing and fewer roller passes to achieve desired compaction levels

Roads treated with Paczyme are safer and less expensive to maintain. Machinery can be utilised for other projects. Fewer complaints will be received from ratepayers regarding problem roads.

Paczyme may be used to increase the maximum dry density (MDD) and unconfined compressive strength (UCS) values of a marginal material to achieve specified standards for a base course and a seal.

Sub-Grade

Paczyme works most effectively on high clay content soils. When applied to a sub-grade material containing clay, increases in UCS values of more than 30% have been achieved. Significant improvements of 5-10% in density have been achieved with limited compactive effort. Increases in strength can save money by decreasing the required thickness of imported base materials.

Paczyme also assists the workability of soils. In situations where heavy moist clay soils will not compact or breakdown, treatment with Paczyme will disperse absorbed water, enabling materials to become loose and friable for working and compaction.

The decrease in air voids and resistance to moisture movement in the compacted sub-grade eliminates swelling characteristics and reduces road failures.

Substantial cost savings may be achieved by using Paczyme to treat sub-grade materials, particularly where materials have very high clay contents and the alternatives to Paczyme treatment include importing large volumes of materials or removal of sub-grade material.

Airstrips

Paczyme can be applied to airstrips, stabilizing clay gravels and increasing their resistance to wet conditions. A noticeable reduction in dust is also evident. Overall maintenance schedules are reduced and the improved surface allows the strip to remain open in otherwise unsuitable weather conditions.

Dams

Paczyme greatly assists in the compaction of clay soils commonly used for dam construction. Greater compaction densities and decreased shrinking and swelling characteristics of clay soils result in decreased permeability for materials treated with Paczyme.

If the proposed soil is sodium dispersive and considered unsuitable for dam building, potassium ions in Paczyme will balance the soil chemistry and alter the dispersive nature of the soil. Standard permeability and pinhole laboratory tests can be used to evaluate the potential benefits of using Paczyme on this type of material.

Cement and Lime Stabilization Aid

The use of Paczyme in conjunction with cement or lime stabilization can greatly enhance the performance of these products. Decreases in the application rate of cement or lime are possible while maintaining strength.

Paczyme assists with the dispersion of the cement or lime throughout the soil, which increases the efficiency of mixing and the binding. Decreasing the amount of additive reduces shrinkage and cracking problems. Paczyme retards the setting action of cement, increasing the time available for working the material and compaction to specified densities.

Conventional stabilization generally required between 2% and 4% inclusion of lime and/or cement. By incorporation Paczyme at a rate of 1 litre to 7 cubic metres to the pavement material, the lime/cement inclusion rate may be reduced to as little as 1-2%, resulting in significant savings.

Cattle Tracks and Feedlots

In circumstances where soil conditions have prevented cattle from walking long distances on farm tracks during the wet season, options to make the tracks passable have included gravel re-sheeting or cement stabilization. Gravel, however, can damage the hooves of cattle and concrete is expensive.

By incorporating Paczyme into local materials and sheeting with a wear course of soft sand on top, it is possible to provide a track surface which enables cattle to access green pasture in wet conditions. This form of track building is relatively inexpensive and initial costs can be recouped in one season.

Significant decreases in permeability that may be achieved by using Paczyme allow it to be used successfully in the construction of feedlots, providing a viable alternative to other more expensive forms of construction.

Cost Saving Benefits

Paczyme increases the water binding productivity by improving the wettability, mixing and compaction. Greater densities are achievable with reduced mechanical effort.

Paczyme modifies the structure of the clay fraction of soil to improve the engineering properties of a soil, enabling greater use of marginal materials that otherwise may have been deemed unsuitable. *In situ* material may be recycled on existing unsealed roads.

Paczyme substantially decreases the permeability of treated material, increasing the resistance to moisture infiltration and reducing damage due to water.

Paczyme increases soil strength, Significant reductions in maintenance schedules save time and money, and allow machinery to be used elsewhere.

Paczyme binds clay fines and reduces the amount of dust generated, improving road safety.

Application

Laboratory Soil Testing

The variability of soil types makes it difficult to determine the possible improvements to the engineering properties of a soil in advance of soil testing and practical field application of the product. The most effective tests are *in situ* field tests for strength, density, durability, permeability and deflection, although it is not always practical to perform these tests. The following laboratory tests can be used to characterise a soil and determine its engineering properties.

Note: Biodegradation of the surfactants in Paczyme takes a minimum of 14 days. Surfactant residues that are present when treated material is re-wet may facilitate the absorption of water to a detrimental degree. Soil tests on Paczyme treated material that require re-wetting should have a dry-back period long enough to allow biodegradation of the surfactants.

Particle Size Analysis

Particle size analysis is a soil grading test that determines the proportions of different-sized particles in a soil. Material is mixed with a dispersant, dried and placed on the top of a series of sieves. The sieves are agitated, and as the material passed through, each sieve collects aggregate ranging in size from rock down to sand, silt and clay. Each sieve is weighed and the percentage passing that sieve is recorded. The approximate clay content of a soil can be determined from the amount of material passing through the 75 micron sieve.

Atterberg Limits

The Atterberg Limits Test determines the consistency of a clay soil, which can range from a viscous liquid to a hard solid depending on water content. The parameters that are measured, namely the Liquid Limit, Plastic Limit and Shrinkage Limit, together are indicative of the behaviour of a soil as it becomes wet. The Plasticity Index (PI) of a soil can be interpolated from these tests to provide an indication of the clay content of a soil.

Maximum Dry Density (MDD)

Maximum dry density is a measure of the maximum density of a soil at its optimum moisture content. As water is added to a soil, it will increase in density. The point at which the soil cannot be further compacted, nearing the zero air void line, is taken to be the optimum moisture content. The addition of more water will cause the soil to become wet and sloppy, and it will decline in density and lose strength. Addition of Paczyme will typically lower the optimum moisture content and increase the maximum dry density, corresponding to a shift towards the zero air void line. Changes in the maximum dry density of soil treated with Paczyme are in the order of approximately 2%.

Unconfined Compressive Strength (UCS)

This test involves the forming up of a core sample in a mould, removing it from the mould (unconfined), drying the sample and placing it under a load. The measurement is taken when the core sample fails by crumbling or cracking. Paczyme consistently shows improvements in strength of between 30% and 35%.

California Bearing Ratio (CBR)

This test is similar to the UCS test except that the sample is not removed from the mould before testing, which limits the drying process. The soaked CBR test is identical other than the sample has been soaked in water for a period of approximately four days. Unless the sample is pulled out of the mould and allowed to dry for a minimum of 14 days before putting it back in the mould and soaking, this test will not accurately reflect what is achievable in the field with Paczyme.

Permeability

Permeability testing is used in the construction of dams, sewerage ponds, catchment areas, rubbish disposal pits and waterways. The rate of flow of water through a core sample is measured. Paczyme treated material consistently shows a decrease in permeability.

Paczyme: Application Rates & Procedures

An application rate of one litre of Paczyme to 4 or 5 cubic metres of soil is recommended, depending on site conditions.

Calculation:

$$\text{Paczyme Required (litres)} - \frac{\text{Soil Volume (m}^3\text{)}}{\text{Application Rate (m}^3\text{/L)}}$$

Example:

Length:	1000m
Width:	6m
Depth:	100mm
Area:	6000m ²
Volume:	600m ³

Application Rate 4 m³/L

$$\text{Paczyme Required: } \frac{600 \text{ m}^3}{4 \text{ m}^3\text{/L}} = 150 \text{ Litres}$$

Paczyme is easily applied with a water truck and standard spraying equipment. Construction equipment normally required for the water-binding process, such as a grader or rotary hoe, is used to mix the product to the desired treatment depth. Treated material is then laid out and compacted following accepted road-building procedures.

1. Rip the area to be treated with Paczyme to the specified depth.
2. Evenly apply the required amount of Paczyme to the soil with a water truck and an adequate quantity of water to raise the soil to just below optimum moisture content.
3. Mix the soil thoroughly with a blade or rotary hoe to ensure that the Paczyme is distributed as evenly as possible throughout the material.
4. Compact using a sheep's foot, steel drum or rubber tyre machine of suitable tonnage. Standard construction practices should be followed.
5. For construction of sealed roads, wet the compacted and shaped surface with a 1:10,000 solution of Paczyme in water.

General Application Tips

Dilution of the Paczyme required for the project is not a critical factor in the performance of the product. The volume of Paczyme required to treat a given volume of pavement material, once determined, can be added in a convenient volume of water. It is only the ratio of Paczyme volume to soil volume which needs to be considered.

For ease of controlling the application rate, and in order to ensure that the optimum moisture content is not exceeded, incorporate the required volume of Paczyme into the first one or two water truck loads for the project. After the material has been sprayed with the Paczyme, the moisture content can be monitored and regulated by adding water only.

How It Works

Paczyme consists of three components which alter the physical and chemical characteristics of a soil to enhance bonding of the soil particles and contribute to the soil stabilization properties of the product.

1. Surfactants

Penetration: Surfactants in Paczyme decrease the surface tension of water and promote the uniform transmission of moisture throughout the soil. Water adhered to clay particles is released. This can result in a significant reduction in the volume of water required in the water-binding process.

Workability: The wetting action of the surfactants lubricates and separates clay colloids and soil particles. The surfactants in Paczyme promote complete coverage of particle surfaces with a microscopic film of water. This results in significantly improved soil workability, requiring fewer grader passes to achieve friable material suitable for compaction. The time required for working the soil for compaction can be reduced by as much as 50% - a significant cost saving and productivity gain.

Compactability: Soils treated with Paczyme can be compacted to load bearing capacities 30-50% stronger than comparable soils compacted with water alone. The lubricating action of Paczyme assists realignment of soil particles. The frictional resistance to compaction is reduced and greater compaction densities are obtained with less compactive effort. Increases in densities of up to 20% can be achieved with the same compactive effort.

Dispersion: Surfactants assist with the transmission of additional active ingredients in Paczyme.

2. Trace Elements

An ionic bond is formed as a result of the attraction between oppositely-charged ions. Ionic exchange refers to the capacity of ions to exchange with other ions which have a smaller net charge. The trace elements in Paczyme participate in ionic exchange reactions with clay particles in the soil. This creates a stronger molecular bond between clay particles. Additionally, much of the absorbed water at the interface of the clay particles is excluded. The inherent moisture content of the soil and the swelling capacity of the clay is greatly reduced by this irreversible reaction.

3. Organics

Organic compounds in Paczyme are the product of the fermentation process during manufacture. They serve primarily to blanket excess ion exchange points in the clay lattice. This will effectively neutralise the negative charges and prevent further absorption of water, which will minimise additional swelling and shrinkage in clay soils.